On the Identity of the Triple Star H I. 13.

By the Rev. W. R. Dawes.

This object is thus described by Sir W. Herschel in his first Catalogue of Double Stars:—

"July 25, 1781. In Constellatione *Aquilæ*, near Fl. 37. A curious treble star. It is the last star of a telescopic trifolium n. following *k*, similar to that in the hand of *Aquarius*. The two nearest very unequal; the third star excessively small, and not visible with 227. The two nearest with 460, no more than half diameter of L; the farthest about 7″ or 8″."

The two nearest were measured by Sir James South at Passy in July and August 1825, with his 7-foot refractor of 5 inches aperture; but on the night of the 28th of July, which he describes as "very favourable for difficult observations," he records, "Sir W. Herschel having described it as a triple star, I applied a power of 413; but no third star could be even suspected." It is distinguished as S 720.

In the Dorpat Catalogue of 1827, Struve has thus described his No. 2541:—"2541, P. xix. 185; $\alpha = 19^h\ 27^m.3$; $\delta = -10^\circ\ 48'$; I. (9) (10.11) = H I. 13." And his No. 2545 is described thus:—"2545, $\alpha = 19^h\ 29^m.0$; $\delta = -10^\circ\ 32'$; I. (6) (8)."

In his "Adnotationes" at the end of the Catalogue, he remarks, with reference to "No. 2541, P. xix. 185. Hanc stellam H I. 13 posui. Est quidem egregia altera duplex classis I. in vicino, No. 2545. Sed hæc est stella magnitudinis sextæ, qualem *Herschelius* non videtur observasse. Neutram tamen triplicem vidi, qualis H I. 13 esse debet."—In his *Mensuræ Micrometricæ*, p. 80, he gives three nights' measures of No. 2541; and at p. 53, five nights' measures of No. 2545. Attached to the former is the remark,—"Dubitari potest utrum hæc stella an 2545 sit Herscheli I. 13."—Though No. 2545 was observed on five nights, on three of which power 480 was used, and on one 600, yet no third star was ever perceived.

There is a second triple star in this vicinity, No. 2547 of Struve's Catalogue. Its Right Ascension is about $12\frac{1}{2}^s$ greater than that of 2545, and it is about 11′ further south. This was observed by Struve on three nights, but *only as double*.

Sir John Herschel reobserved S 720 on three nights in 1828 and 1830. (Nos. 553–555 of the 364 Double Stars. *Mem. R. Ast. Soc.* vol. v. part i. p. 69). In one of his notes at the foot of the page he remarks, "Taken for Σ 2545;" and in another, "This is S 720. It cannot be H I. 13." *Why*, is not stated. No third star was seen on any occasion. Sir John also observed a double star which he designates Σ 2545 (No. 556 of the 364); but the angle of position differs so widely from Struve's, that either there is a large error in it, or another object has been observed, which, however, I have failed to find. No. 557 is rightly called Σ 2547, and the

position and distance agree well with Struve's; but the third star has escaped Sir John as well as Struve.

In 1835, Admiral Smyth observed two objects in this locality, which constitute Nos. 702 and 703 of the "Bedford Cycle." The former is marked as *triple;* the latter as *double only.* No. 702 is thus described:—"A delicate triple star, on the right knee of *Antinous*. . . . A 9, light yellow; B 10, cerulean blue; C 12, violet tint; and the three lie nearly in a line pointing to a distant small star in the *s. f.* quadrant."—It is stated to be P. xix. 185, and to be identical with H I. 13, with S 720, and with Σ 2541,—the positions and distances of those stars, as determined by the respective observers, being quoted for comparison. With reference to the third star overlooked by Struve and South, he adds, "It is plain enough in my refractor. I therefore conclude Sir James must have measured the following instead of 13 H I." Smyth gives as the results of his own observations of 702:—

A B	P = 338·4 (*w*. 4)	D = 3″·2 (*w*. 2)	Epoch 1835·58
A C	153·5 (*w*. 2)	8·0 (*w*.)	

And the mean place of the star for 1840 is given thus:—

R.A. $19^h\ 28^m\ 1^s$	Prec. $+\ 3^s·30$
Decl. S. 10° 46′·8	— N. 7″·51

Of the Cycle No. 703, Smyth gives as the mean place for 1840:—

R.A. $19^h\ 28^m\ 5^s$	Prec. $+\ 3^s·30$
Decl. S. 10° 30′·4	— N. 7″·52

and he considers it to be identical with P. xix. 186.

As the results of his measurements of this star he gives:—

P = 315°·7 (*w*. 6) D = 3″·8 (*w*. 3) Epoch 1835·58;

and he describes the object thus:—"A very neat double star on the right knee of *Antinous*, and closely following the above-described object. A 7½, pale white; B 9, sky-blue; and they are followed by another double star nearly on the parallel. There can be little doubt of this object's having been measured for 185 P.; for, though it is considerably brighter and more open, yet there is certainly a great resemblance in the position and distance of A and B. This is the No. 2545 of the great Dorpat Catalogue."

Wishing to determine, if possible, which of the two objects in this vicinity at all resembling H I. 13, was really that star, in October 1859 I directed toward the place my 8¼-inch re-

fractor. Having identified 37 (*k*) *Aquilæ*, which is, in fact, a good fifth magnitude star, and plainly visible to the naked eye, I carefully examined all the stars north-following 37 which were visible along with it in the finder of 2 inches aperture and power 23. The nearest double star to 37, and, with reference to that star, about 8′ 35″ n. f. $2^m\ 12^s$, was obviously Σ 2541; the second was about 24′ 44″ n. f. $4^m\ 7^s{\cdot}5$, and agreed in place with Σ 2545; and a third was about 13′ 41″ n. f. $4^m\ 20^s$, and agreed in place with Σ 2547. The mean place of 37 *Aquilæ* deduced from the B. A. C. was for 1860·0, R.A. $= 19^h\ 52^m\ 52^s{\cdot}66$, and N.P.D. = 100° 52′ 52″·5. In referring to each of these objects I shall designate them by Struve's numbers.

Σ 2541. Instantly seen *double;* looked carefully for a third star; none could be found. Magnitudes, A = 8½; B = 9½. Pos. = 340° ±; Dist. = 2″·5 ±.

Σ 2545. Instantly seen *triple.* Mag. A = 6½; B = 8; C = 11¼, *blue.* A B, Pos. = 315° ±; Dist. = 3″·0 ±. A C, Pos. = 170° ±; Dist. = 25″ ±.

Σ 2547. Obviously *triple.* Mag. A = 7½; B = 9; C = 10½. A B, Pos. = 330° ±; Dist. = 20″ ±. A C, Pos. = 140° ±; Dist. 45″ ±. *The three are nearly in a line.*

Of these three objects, I have not the slightest doubt that the *second*, Σ 2545, is H I. 13.

The only circumstance which presents any difficulty in the way of this conclusion is, that the distance of C from A is much greater than was estimated by Sir W. Herschel. But the marvel rather is that he *discovered* it at all with his 7-foot Newtonian; and a mere guess at the distance of a scarcely perceptible point of light may easily be much in error. A similar and very remarkable instance occurs in the distance of A C of Cycle 702, which was estimated by Smyth at 8″, though its real distance is between 40″ and 50″. It was, in fact, a mere guess, with *no weight* attached to it.

That the third star of H I. 13, should have escaped the scrutiny of such observers as South, Herschel II., Smyth, and especially Struve with his powerful Dorpat refractor; and yet should have been seen at all by Herschel I. with a reflector of only 6⅓ inches aperture (about equal in light to a refractor of 4½ inches aperture), and then, after lying hid for nearly eighty years, should have been caught up at the first glance with a telescope 1⅓ inch smaller in diameter than Struve's (and whose illuminating power is therefore only as 68 to 92) might seem almost with certainty to point to *variability of light*, as the only probable solution of the difficulty. Yet, during three years, since 1859, I have on various occasions examined it with a special view to this point, and have never found any proof of it, or even ground of suspicion. It is true that on a very clear night (19th August, 1862) I saw it with a refractor of only 4 inches aperture by Cooke of York, and with so low a power as 135; but, on viewing it with my 8¼-inch, I found

that all the faint stars in the neighbourhood were proportionably brighter than usual from the transparency of the atmosphere. The fact that Struve on three different nights overlooked the third star of Σ 2547, of which Smyth says, "It is plain enough in my refractor," and which has three or four times the light of the third star of Σ 2545 (H I. 13) is sufficient to show how easily such objects may be rendered invisible at a small altitude by a little unsuspected haze. Yet it would be highly desirable that this object should be put upon the list of "Suspected Variables." Of course, at such an altitude, great caution is required; and it will be necessary to compare it with two or three very faint objects in its immediate vicinity.

Hopefield Observatory, Haddenham,
October 1862.

Remarks on some Astronomical Eye-pieces.

By the Rev. W. R. Dawes.

As the improvement of astronomical eye-pieces must always be interesting to telescopic observers, it is hoped that a few remarks on that subject may not be unacceptable. They will have special reference to a paper by Mr. T. W. Burr, printed in the *Monthly Notices* for June 1862, in which he particularly recommends an eye-piece lately constructed by Mr. Thornthwaite, and, in consequence of its freedom from the defects of those in ordinary use, named the "Aplanatic" eye-piece.

It does not appear to be generally known that the late Carl Kellner, of Wetzlar, in Prussian Rhine, employed the same, or very nearly the same, form for his telescopes as for his microscopes—I have seen several of them. The field-lens in all was double convex; and so nearly equi-convex (in some, at least) that I could not discover that they were not exactly so. The eye-lens was a meniscus; and they all had a stop, or diaphragm, in the focus of the meniscus, and very near the field-lens. One of these, which produced a power of 80 on my telescope, had a field of 37′ 10″ in diameter; and, consequently, the angular subtense of the diaphragm = 49° 33′. Being directed to the full moon on the 8th of November, 1851, it embraced the whole of it with a considerable margin. On that night the moon's diameter was 30′ 6″; and, consequently, the breadth of the margin all round it was 3′ 32″. The focus being carefully adjusted on a well-defined object near the centre of the moon, the edge was very distinct all round without any perceptible colour.

In the year 1855, Professor Steinheil of Munich sent me three eye-pieces, the construction of which he considered an